

TABLE 2.—Free-air resultant winds (m. p. s.) during January, 1929

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters																								
Surface	N.49 W.	0.8	S.51 W.	1.0	N.82 W.	0.5	N.81 W.	1.3	N.50 W.	3.1	N.63 W.	3.1	S.25 W.	2.4	S.68 W.	0.5	S.79 W.	2.6	S.58 W.	2.2	N.64 W.	1.2	N.44 W.	1.7
200	N.47 W.	0.8	S.47 W.	1.2	N.85 W.	0.6	N.84 W.	1.5	N.52 W.	3.3	N.67 W.	3.6	S.29 W.	1.9	S.69 W.	0.8	S.74 W.	2.4	S.54 W.	2.6	N.73 W.	3.6	N.71 W.	3.7
400	S.58 W.	1.4	S.39 W.	2.3	S.77 W.	2.7	S.86 W.	3.1	N.57 W.	4.6	N.65 W.	5.7	S.45 W.	3.3	S.54 W.	2.1	S.72 W.	3.6	S.61 W.	5.2	N.72 W.	7.4	N.73 W.	3.7
600	S.53 W.	2.3	S.46 W.	3.2	S.89 W.	4.4	S.85 W.	4.7	N.52 W.	4.6	N.65 W.	5.7	S.44 W.	4.7	S.56 W.	3.1	S.72 W.	3.6	S.61 W.	5.2	N.72 W.	7.4	N.73 W.	3.7
800	S.53 W.	2.3	S.46 W.	3.2	S.89 W.	4.4	S.85 W.	4.7	N.52 W.	4.6	N.65 W.	5.7	S.44 W.	4.7	S.56 W.	3.1	S.72 W.	3.6	S.61 W.	5.2	N.72 W.	7.4	N.73 W.	3.7
1,000	S.61 W.	2.9	S.61 W.	3.8	S.82 W.	5.8	S.83 W.	6.0	N.57 W.	5.5	N.63 W.	6.7	S.54 W.	5.6	S.60 W.	3.9	S.70 W.	5.8	S.69 W.	7.0	N.72 W.	10.0	N.72 W.	7.7
1,200	S.79 W.	3.7	S.73 W.	4.4	S.86 W.	6.7	S.88 W.	8.0	N.61 W.	6.3	N.62 W.	7.8	S.63 W.	6.3	S.67 W.	4.9	S.69 W.	6.9	S.82 W.	8.9	N.69 W.	10.9	N.71 W.	8.4
1,400	N.89 W.	5.0	S.77 W.	5.5	S.78 W.	8.1	S.87 W.	10.1	N.61 W.	7.4	N.63 W.	8.4	S.70 W.	7.2	S.72 W.	6.0	S.70 W.	7.2	S.85 W.	10.3	N.67 W.	11.6	N.70 W.	11.0
1,600	N.89 W.	5.0	S.77 W.	5.5	S.78 W.	8.1	S.87 W.	10.1	N.61 W.	7.4	N.63 W.	8.4	S.70 W.	7.2	S.72 W.	6.0	S.70 W.	7.2	S.85 W.	10.3	N.67 W.	11.6	N.70 W.	11.0
1,800	N.82 W.	7.3	S.85 W.	7.5	S.83 W.	11.3	S.89 W.	12.5	N.58 W.	10.2	N.63 W.	11.0	S.80 W.	8.4	S.79 W.	7.2	N.74 W.	11.4	S.87 W.	12.1	N.66 W.	13.5	N.72 W.	11.1
2,000	N.87 W.	9.1	W.	9.0	S.77 W.	14.3	S.88 W.	14.9	N.63 W.	12.1	N.65 W.	13.0	N.80 W.	9.2	S.82 W.	8.5	N.63 W.	8.9	N.89 W.	13.4	N.71 W.	15.4	N.79 W.	15.6
2,200	N.84 W.	11.7	N.87 W.	10.3	S.70 W.	13.0	S.87 W.	15.9	N.61 W.	15.4	N.65 W.	14.6	S.88 W.	10.0	S.82 W.	8.9	N.63 W.	8.9	W.	14.2	N.67 W.	18.4	N.80 W.	15.5
2,400	N.79 W.	11.2	N.84 W.	10.9	S.63 W.	14.8	S.84 W.	16.1	N.75 W.	12.4	N.66 W.	15.4	S.83 W.	8.9	S.84 W.	10.9	S.45 W.	18.0	S.94 W.	13.4	N.68 W.	16.5	N.77 W.	17.0
2,600	S.76 W.	10.3	N.84 W.	10.8	S.69 W.	17.1	S.84 W.	15.6	S.68 W.	19.0	N.63 W.	16.7	S.78 W.	14.3	S.75 W.	12.1								
2,800					S.45 W.	20.0	N.87 W.	8.4					S.78 W.	14.7	S.75 W.	14.1								
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## THE WEATHER IN THE UNITED STATES

## THE WEATHER ELEMENTS

By P. C. DAY

## GENERAL CONDITIONS

Unlike the first month of the winter of 1928-29, January was a notably cold and disagreeable month over nearly all northern districts, with deep snows from the upper Mississippi Valley eastward to and including the Great Lakes. In other districts, however, normal winter conditions prevailed as a rule.

## PRESSURE AND WINDS

The month was ushered in with a cold wave over the Great Plains and a cyclone of wide proportions centered near the Great Lakes, and rain or snow had fallen during the preceding 24 hours over a wide area from the Great Plains eastward nearly to the Atlantic coast, heavy snow being reported at points in the lower Missouri Valley and over other near-by areas. This storm moved rapidly to the lower St. Lawrence Valley by the morning of the 2d, the snow continuing in portions of the Great Lakes region, but precipitation had generally ended to the southward and fair weather prevailed on the 3d over most districts.

A cyclone that had developed over the Southwest without material precipitation was centered over the lower Missouri Valley by the morning of the 4th and widespread precipitation had covered the Great Plains and eastward to the Mississippi Valley, snow occurring over the districts to northward of the center and some heavy rains to the southward. During the following day precipitation extended eastward to the Atlantic coast, snow continuing over northern districts and rain over the more eastern and southern, followed by a wide area of cold that carried freezing temperatures to or near the Gulf coast within a few days. During this period warmer weather overspread the western districts and, with the passage of the precipitation area into the Atlantic, fair weather prevailed over nearly all districts, a change to colder following quickly over the central valleys and this again by warmer, changes amounting from 20° to 50° in 24 hours being reported from points in the upper Mississippi Valley and other areas.

By the 9th another cyclone had developed over the southern plains and within the following 24 hours the storm center had moved to the northward of the Great

Lakes and precipitation, mostly rains, had extended to all central and eastern districts, except the extreme Southeast. At the same time high pressure dominated the plateau region and by the end of the first decade the weather had cleared over most districts except along the northern border where clouds and local precipitation, mostly snow, persisted for several days.

About the 17th stormy conditions had developed in the central valleys and precipitation was more or less general from the Mississippi Valley eastward; similar conditions continued for several days, during which time widespread snows occurred over the western mountains and general rains occurred over many eastern districts. By the end of the second decade fair and cold weather had overspread most northern districts, continuing with some interruption during the remainder of the month, more or less rain or snow falling at intervals during the period, but particularly about the 25th, when a cyclone advanced from southern Texas to the Great Lakes, becoming severe as it approached the latter area and attended by rain or snow and high winds. During this period cold weather continued in the far Northwest.

Anticyclonic conditions existed during much of the latter half of the month over the far Northwest and also in the Missouri and upper Mississippi Valleys.

General high winds occurred over portions of the upper Mississippi Valley and Great Lakes region on several dates in connection with cyclones passing over those regions, causing much drifting of snow, and resulting in inconvenience and delay to transportation, but these caused no important damage to property.

Severe local storms assuming tornadic force occurred locally in Texas on the 4th and in Kentucky, Indiana, Illinois, and Missouri on the 18th. A full account of the principal destructive wind storms of the month appears as usual at the end of this section, and the details of wind direction and barometric pressure data are shown on the usual charts.

## TEMPERATURE

Cold weather prevailed at the beginning of the month over the central valleys, but there was some warming up generally as the week advanced over most central and eastern districts, followed quickly by sharp changes to colder and again to warmer toward the end of the week, the average temperature for the period being moderately below normal over the greater part of the country, and

distinctly below from the Gulf States northward to Canada.

The second week had some marked temperature changes in the northern and central districts from the Rocky Mountains eastward and the weekly means were again below normal from the Ohio and middle Mississippi Valley northward, elsewhere they did not depart greatly from the normal, being generally well above, however, from Texas northwestward to the Canadian border.

The week ended January 22d averaged much colder than normal over the northern districts from the upper Lakes westward to the Pacific coast and over the far Southwest, the week being particularly cold over the upper Missouri Valley and the far Northwest. This week, as a whole, was distinctly warmer over the Gulf States and near-by areas. The last decade of the month was bitterly cold over the northwestern districts, the averages for the week ranging from 15° to 30° below the normal for the period, from the upper Mississippi Valley westward to the plains of Washington and Oregon, and cold weather existed throughout the remaining sections save in the southern portions from Texas eastward to the south Atlantic coast and over portions of the southern drainage area of the Ohio. In portions of the upper Missouri Valley and near-by States this period was one of the coldest of record and in many sections of this area the highest temperatures during the period did not rise above zero and the lowest values ranged from 30° to more than 50° below zero.

For the month, as a whole, average temperatures were below normal over all parts of the country save the southern tier of States and along the Atlantic coast northward to New England. At numerous points along the northern border from Lake Superior westward it was among the coldest Januarys of record.

The coldest periods of the month were mainly toward the end, though over the Gulf and South Atlantic States they occurred mainly about the 3d and from the Ohio Valley and Lake region eastward near the 15th. The lowest temperature reported, -56°, was observed at a point in Montana.

Some unusually high January temperatures occurred in Ohio on the 18th and 19th and in Florida on the 21st. Maximum day temperatures did not rise above 50° at any time during the month in the upper Lake region and in some States to the westward.

#### PRECIPITATION

The monthly amounts of precipitation were below the normal over all the far Western States as was the case during the preceding month, and also in November over the northern section of that area. The deficiency was par-

ticularly large in the coastal districts, where many stations had less than one-third the usual fall. Precipitation was likewise less than normal over most of the Atlantic Coast States and in the Appalachian Mountain region and locally in the middle and southern Rocky Mountain and Plains States.

Precipitation was above normal over nearly all northern and central districts from the mountains of Idaho and Utah eastward to the Ohio Valley and Great Lakes region. In portions of the upper Mississippi Valley and in the vicinity of the upper Lakes the month was in many instances the wettest January of record. Much cloudy, rainy, or snowy weather prevailed, and with glaze that formed on several occasions, caused ice coatings that interfered greatly with traffic and made travel dangerous.

#### SNOWFALL

Over the Northern States from the Dakotas eastward to and including the Great Lakes the monthly snowfall was unusually heavy and in many sections of this area, particularly in the upper Mississippi Valley and the near-by portions of adjoining States, the snowfall was the greatest ever experienced in any January, and locally the greatest in any month of record. Over other sections of the country where snow is usually heavy to moderate, notably in New England and near-by districts, the January snowfall was mainly less than normal and this was the case likewise in the southern districts where snow usually falls to appreciable depths.

In the western mountains snowfall was normal or above throughout the Rocky Mountain region and generally somewhat above in the mountains of the Plateau. On the higher elevations of Washington and Oregon the snowfall was mainly satisfactory, but at the high elevations of the Sierra Nevada in California and Nevada the stored snow was materially less than is usually accumulated by the end of January.

Considerable amounts of glaze formed in the upper Mississippi Valley and Lake region, making travel unsafe locally for considerable periods, and numerous accidents occurred.

#### RELATIVE HUMIDITY

The average relative humidity was generally above normal over most districts from the Great Lakes westward and southwestward to the Pacific coast, but from the southern portions of Arizona and New Mexico eastward and northeastward to the Atlantic coast the average humidity was mainly less than normal, a few exceptions being noted near the south Atlantic coast and in the west Gulf coast sections.